Title of the thesis: EXPLORATION OF CYTOMORPHOLOGICAL DIVERSITY IN THE MEMBERS OF POLYPETALAE FROM LAHAUL-SPITI AND ADJOINING AREAS

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Present work pertains to cytomorphological studies in the plants of Polypetalae from the cold deserts of Lahaul-Spiti and its adjoining areas. The area remained covered with snow for more than 6 months. Temperature during winter falls as low as -30°C. Air is very dry and strong winds blow almost throughout the year at higher elevations. The mountain ranges here consist of rugged mountains, snow clad peaks, bare rocks, and steep sandy slopes with rock gravels. As a consequence of harsh climatic conditions prevailing in the region, plants tend to become prostrate, thick, hairy, bushy, hardy, sturdy, mat and cushion forming, and spiny with long roots and small succulent or woolly leaves. Majority of the plants perennate through rootstocks, runners, bulbs, rhizomes and tubers. The area is under considerable pressure of human intervention and natural disasters which include agriculture, heavy grazing, snow avalanches, windstorms, landslides, increasing entry of tourists and transport vehicles, and overexploitation of medicinally important plants. So far no serious attempt has been made to explore the cytomorphological diversity in the flora of Lahaul-Spiti and its adjoining high altitudinal areas. Present cytomorphological investigations included 140 species belonging to 72 genera. All the species have been studied meiotically for the first time from the area. Chromosome counts in 14 species are the first ever reports. As many as 41 species have been counted chromosomally for the first time from India. Chromosome counts in seven species are the first ever records at sub-species/variety level. New intraspecific diploid or polyploid cytotypes are recorded in 13 species. New intraspecific aneuploid cytotypes (indicated as in bold) are recorded in eight species. Presence of variable number of B-chromosomes are recorded for the first time in Sedum oreades (n=11+0-4B) and Delphinium vestitum (n=8+0-1B). Morphogenetic variation are detected in some species are attributed to ploidy level. On the other hand, the morphovariation in Geranium
wallichianum, Impatiens thomsonii (Thalictrum foetidum) seem to have a genetic basis. The phenomenon of cytomixis involving inter PMC transfer of chromatin material has been found to be quite common in the species of these cold deserts. Presently cytomixis had been recorded in 31 species. In most of the cases chromatin transfer among proximate PMCs resulted into hypo-, hyperploid and enucleated PMCs. Cytomixis also induced various meiotic abnormalities in the meiocytes which include pycnotic chromatin, interbivalent/chromosomal connections, extra chromatin masses, laggards, chromatin bridges, chromatin stickiness, supernumerary nucleoli and spindle irregularities resulting in abnormal sporads (triads, polyads and tetrads with micronuclei). The products of such sporads resulted into varying amount of pollen sterility and heterogeneity in the size of pollen grains. Cytomixis in all these cases seem to be a natural phenomenon under the genetic control influenced by environmental factors especially freezing temperature stress prevailing in the area. Syncyte meiocytes noticed presently in few species are resulted due to direct fusion of PMCs during the earlier stages of meiosis. The products of such syncyte PMCs yielded large sized ('2n') pollen grains. Role of polyploidy in the evolution of species of these cold deserts is quite significant as 51 species (36.43 %) existed at various polyploid levels. Some of the species depicted high level of ploidy. Role of polyploidy in the evolution of these species is also apparent as 57 species exhibited intraspecific polyploidy at different levels. Aneuploidy causing chromosomal variations is equally important as 37 species depicted the existence of intraspecific aneuploid cytotypes at diploid and/or polyploid level. Majority of the aneuploid and polyploid species are observed to be perennial in nature and perennate by means of rootstocks, rhizomes and stolons. It thus indicates that the chromosomal variation is associated with the vegetative mode of reproduction. Another important finding recorded presently in the plants of cold deserts included synaptic irregularities, spindle abnormalities, syncytes, cytomixis, aberrant cytokinesis, pollen fusion and formation of restitution nucleus which resulted into the formation of unreduced ('2n') gametes in the form of large/giant pollen grains. These '2n' gametes may play a role in the production of polyploids. Harsh climatic conditions particularly freezing temperature prevailing in the area seem to have caused various meiotic abnormalities in the plants which affected the genetic constitution and viability of male gametes and lead to reduced reproductive success through seeds. In turn the plants of the area have adopted the alternate means of propagation through agamospermy (vegetative means like rootsuckers, rhizomes, stolons, bulbs and tubers).